Reduction of operator exposure during mixing and loading with Closed Transfer Systems

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Closed Transfer Systems (CTS) are mechanical systems for plant protection sprayers, which prevent the operator from contamination with the concentrated plant protection product (PPP). They can be used with standard PPP containers with screw cap. To compare different systems, it is necessary to quantify the operator exposure during mixing and loading with sufficient accuracy. Therefore a new measuring method using whole body dosimeters and fluorescent tracer was developed.

In the conventional process the operator opens the cap and the sealing of a PPP container, fills the product into the sprayer and rinses the container with clear water. The fluid path from the container to the sprayer is open in this case. Exposure of the environment and the operator's body can occur easily. A CTS provides a technical improvement to this problem by connecting the container to the sprayer via adaptors. The opening of the sealing as well as the product transfer and rinsing of the empty container happens in a closed system with minimized contamination of the operator.

To measure the human exposure of the operator under realistic conditions, both during conventional filling or filling with CTS, experiments were done with different test persons. Protective clothing consisting of overall, protective gloves and visor was used as dosimeters to collect the fluid. Additionally a layer of long underwear and laboratory gloves was used as inner dosimeters that represent the human skin. In every experiment four containers filled with fluorescent pyranine solution were transferred into the tank of the sprayer and rinsed afterwards. The exposure of all dosimeter types was separately evaluated with fluorescence spectroscopy.

In the first step, the operator exposure for a conventional filling of different container sizes (1 liter, 5 liter and 10 liter) was investigated. The container causing the highest exposure was then used in the second part where different sprayer configurations were compared. At first the experiments were done at the induction hopper of the sprayer, which is the current state of technology. The experiments were done by three different operators with the CTS called easyFlow by agrotop GmbH and without the system. After that the procedure was repeated at the dome shaft of the sprayer tank.

The results confirm a strong reduction of operator exposure with the tested CTS. The protective gloves collect the highest amount of fluid. Also the exposure of the overalls is high in some cases. Other dosimeters like long underwear, laboratory gloves and visors have shown to be less important for the assessment of operator exposure. The measuring method has proved to be sufficiently accurate and a new guideline for testing the operator exposure of different CTS will be created based on it.